

Trends in Long-Term Ecological Data: a multi-agency synthesis project



Project Leader: Debra Peters, USDA ARS, Jornada Experimental Range, Jornada Basin LTER & Sevilleta LTER, Las Cruces, NM USA

Project Coordinator: Christine Laney, New Mexico State University, Jornada Basin LTER, Las Cruces, NM USA



Introduction: Long-term ecological research sites within the U.S. date to 1902 when the Santa Rita Experimental Range was set aside as a research center. By 1980 when the Long Term Ecological Research (LTER) program was established, 78 experimental forests and more than 10 rangeland research stations had been conducting research, in most cases for more than 40 years. Currently this large suite of National Science Foundation (NSF) and United States Department of Agriculture (USDA) supported sites, including 26 LTER sites, represents a wide range of ecosystem types from forests to grasslands and shrublands, freshwater lakes and streams, near coastal marine and estuaries as well as urban areas and systems in the arctic and Antarctica. A variety of different kinds of data have been collected from these sites through time, ranging from primarily climatic and demographic data since the 1800s to more recent quantitative assessments of plant, animal, and microbial populations and communities, hydrological and biogeochemical cycles, biodiversity, and disturbance regimes. In addition, pollen records and tree-ring data can be used to push data availability back even further.

As the LTER enters its “Decade of Synthesis”, the United States Forest Service (USFS) enters its “New Century of Service”, the USDA Agricultural Research Service (ARS) enters the time when “The Future Grows Here”, and new initiatives, such as the National Ecological Observatory Network (NEON) become operative, there is a critical need for a collection of highly accessible, up-to-date, and easy to use data sets that span the ecosystems and history of the U.S.

Goals: Create a platform for synthesis by making long-term data available, and illustrate the utility of this platform in addressing important within-site and network-level scientific questions

Products: (1) a book to be published by Oxford University Press that focuses on trends in long-term data within and among sites, and examples that illustrate the value of long-term data in addressing important questions for a number of sites, and (2) a web page containing derived long-term data and metadata that are easily accessible for synthetic analyses by a variety of users

Opportunities: We are continuing to collect data and graphs to illustrate long-term trends for each site. Contact Deb Peters (debpeter@nmsu.edu) to contribute to this project. Each figure in the book will be referenced by the PI responsible for the original data. All data used in the Trends project will be made available on the Trends web page with links to the original data and metadata, including PI contact information.

Collaborators:

26 LTER sites

LTER Network Office (LNO)

14 USFS Experimental forest sites

New Mexico State University

9 USDA Agricultural Research Service rangeland sites

National Center for Ecological Analysis and Synthesis (NCEAS)

National Science Foundation (NSF)

Editorial Committee:

Ariel Lugo [LUQ, USFS]

Mark Ohman [CCE]

Tim Kratz [NTL]

Charley Driscoll [HBR]

Debra Peters [JRN, ARS]

Charlene d'Avanzo [Hampshire College, Education Representative]

Scott Collins [SEV]

Peter Groffman [HBR]

Morgan Grove [BES, USFS]

Bob Waide [LUQ, LNO]

Christine Laney [JRN]

Technical support:

James Brunt, Duane Costa, Inigo San Gil, Mark Servilla, Marshall White [LNO]

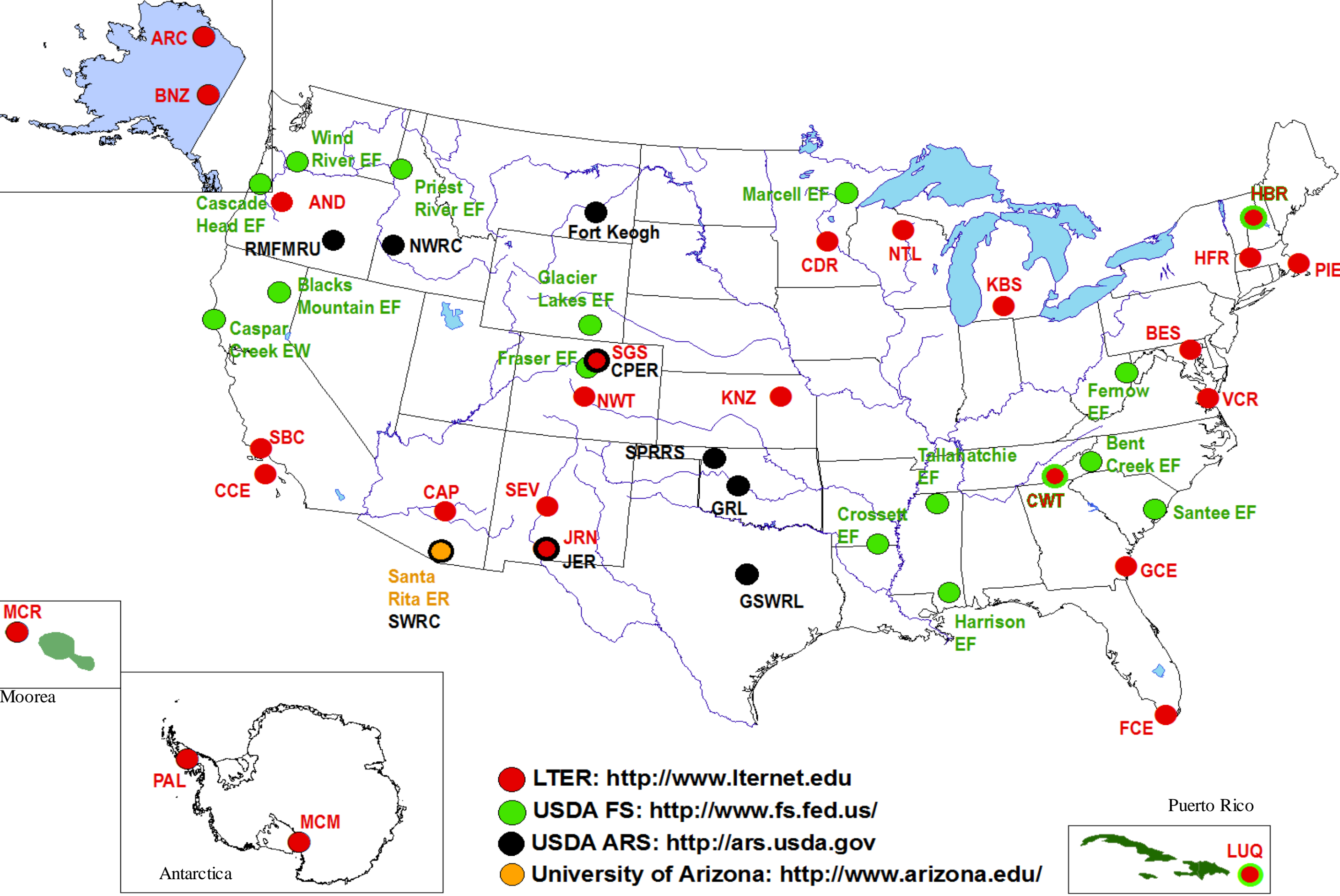
Wade Sheldon [GCE, LTER Network Information Systems Advisory Committee]

Ken Ramsey [JRN, LTER Information Management Executive Committee]

Mark Schildhauer [NCEAS]

Don Henshaw [AND, LTER NISAC]

Currently participating long-term research sites



Site Abbreviations:		
ARC: Arctic LTER	FCE: Florida Coastal Everglades LTER	KNZ: Konza Prairie LTER
AND: Andrews LTER	GCE: Georgia Coastal Ecosystems LTER	LUQ: Luquillo LTER
BES: Baltimore Ecosystem Study LTER	GRL: Grasslands Research Laboratory	MCM: McMurdo Dry Valleys LTER
BNZ: Bonanza Creek LTER	GSWRL: Grassland Soil and Water Research Laboratory	MCR: Moorea Coral Reef LTER
CAP: Central Arizona - Phoenix LTER	HBR: Hubbard Brook LTER	NLT: Northern Temperate Lakes LTER
CCE: California Current Ecosystem LTER	JRN: Harvard Forest LTER	NWT: Niwot Ridge LTER
CDR: Cedar Creek LTER	JER: Jornada Experimental Range, ARS	VCR: Virginia Coast Reserve LTER
CPER: Central Plains Experimental Range, ARS	JRN: Jornada Basin LTER	PAL: Palmer Station LTER
CWT: Coweeta LTER	KBS: Kellogg Biological Station LTER	PIE: Plum Island Ecosystem LTER
		RMFMRU: Range and Meadow Forage Management Research Unit
		SWRC: Southwest Watershed Research Center



- The primary themes are**
- 2) Biogeochemistry** (top left, calcium addition to litter at Hubbard Brook LTER),
 - 3) Climate & disturbance** (bottom left, fire at Konza Prairie LTER),
 - 4) Biotic structure** (top right, forests of Luquillo LTER), and
 - 5) Human population and economy** (bottom right panel: left, Central Arizona-Phoenix Urban LTER; center & right, Baltimore Ecosystem Study LTER). Photos courtesy of the LTER network.

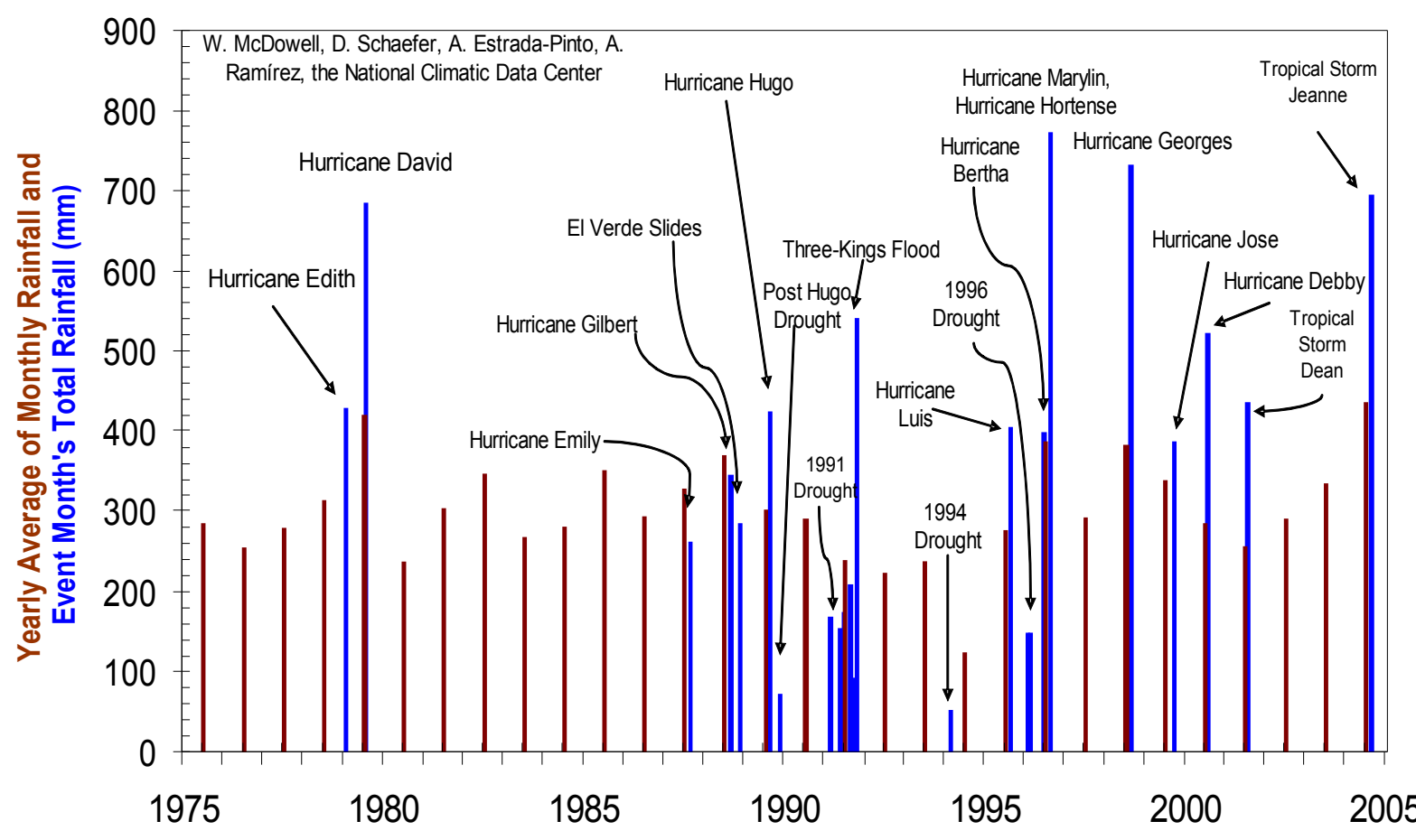
Coming soon: The Trends website
www.ecotrends.info



Examples of within-site trends

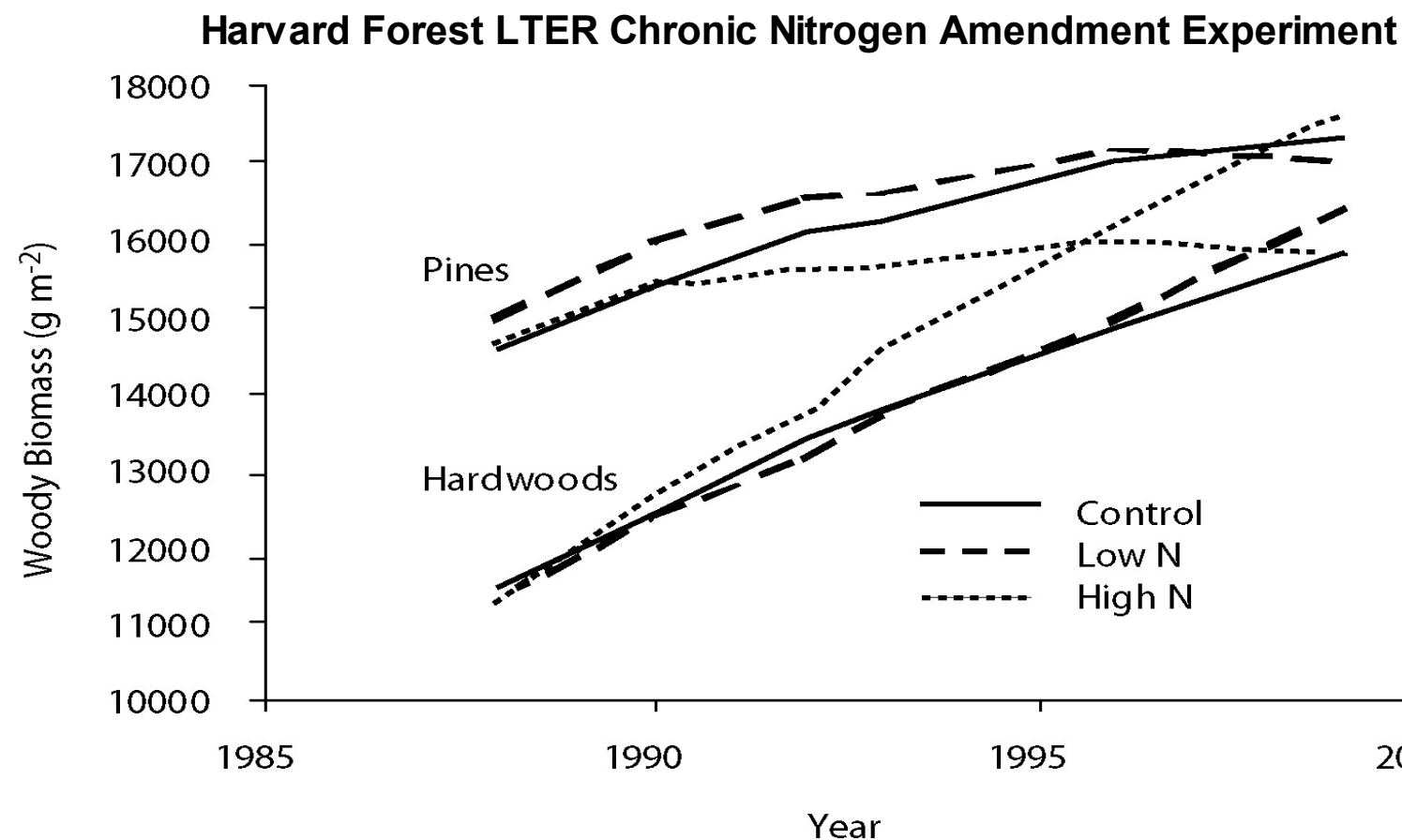
(organized by themes in LTER Planning Process)

Disturbances



Chronology of disturbance events since 1979 at the Luquillo Experimental Forest (LUQ, LTER & USFS). Events are identified only by rainfall intensity. Data gathered by W. McDowell, D. Schaefer, A. Estrada-Pinto, A. Ramirez, of the Luquillo LTER (LUQ LTER) and the US Department of Commerce National Climatic Data Center. Chart design by F. Scatena and E. Meléndez-Colom of Luquillo LTER.

Biogeochemistry



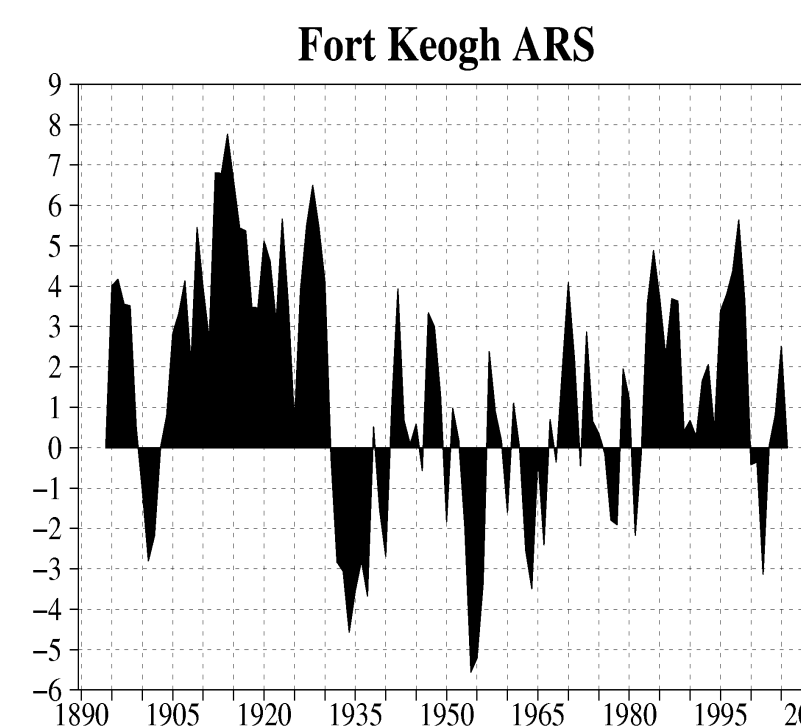
Comparison of changes in total woody biomass over time in the red pine and hardwood plots as a consequence of chronic N additions. Total accumulation in the high-N pine plot is significantly lower than in the control and low-N plots, while in the hardwood stand accumulation is highest in the high-N plot.

Source = Forests in Time, fig. 12.5

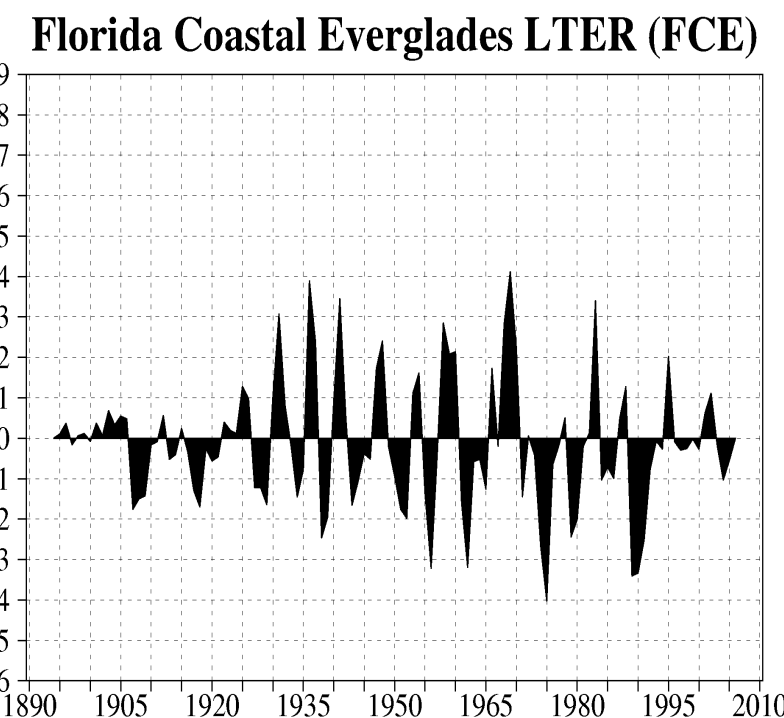
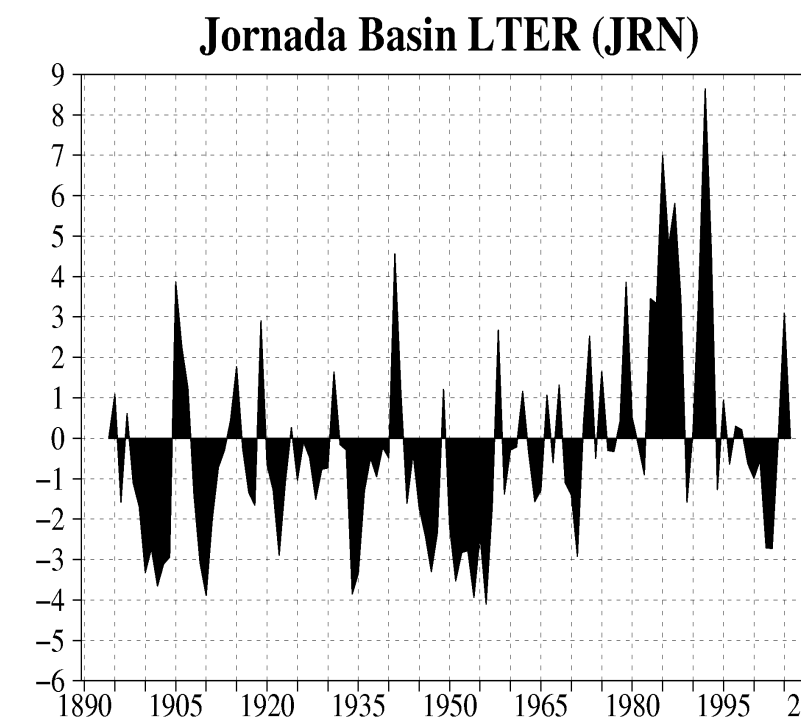
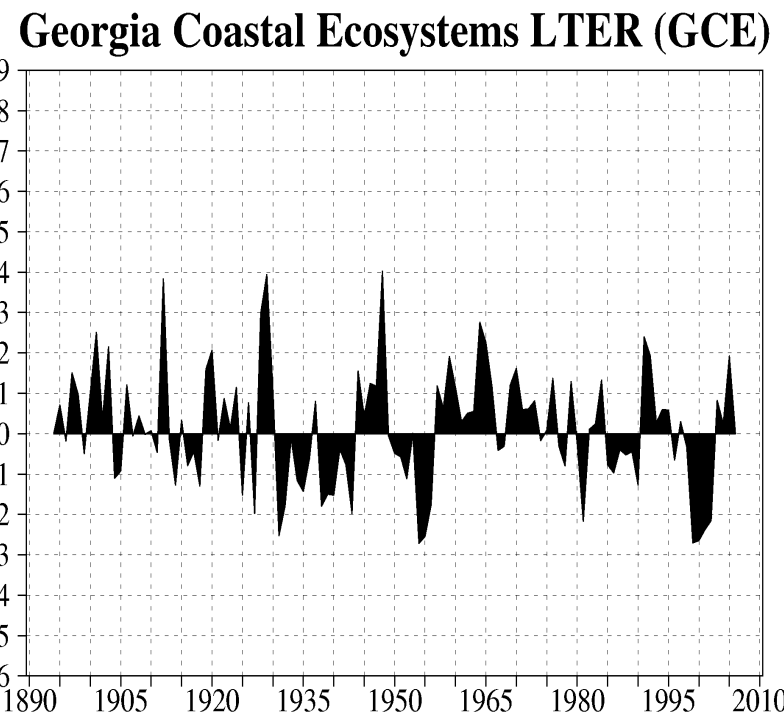
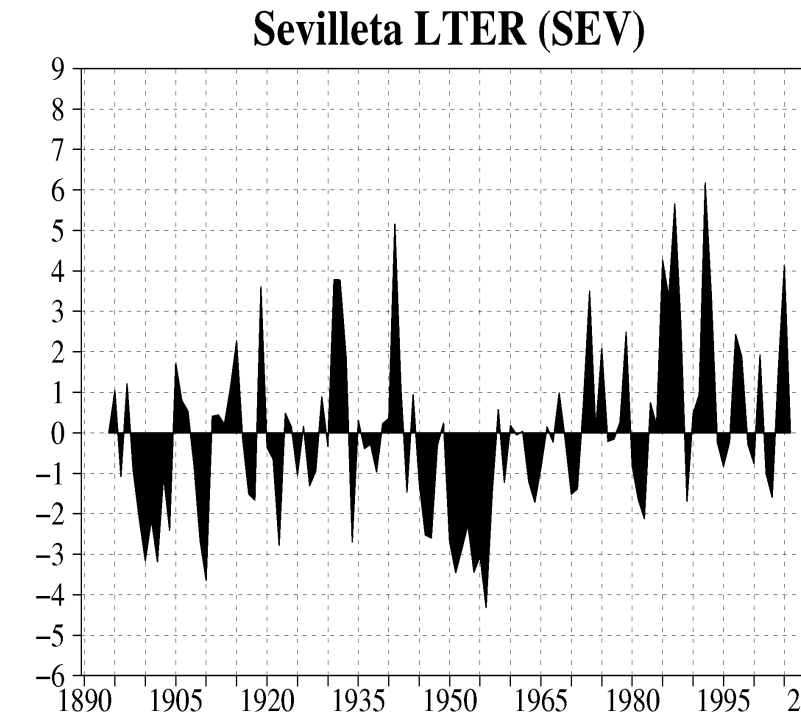
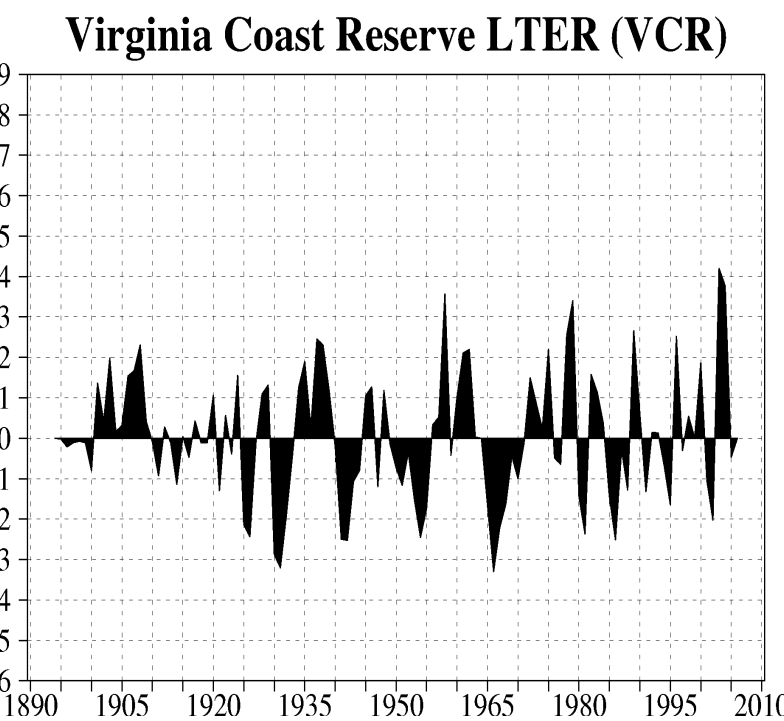
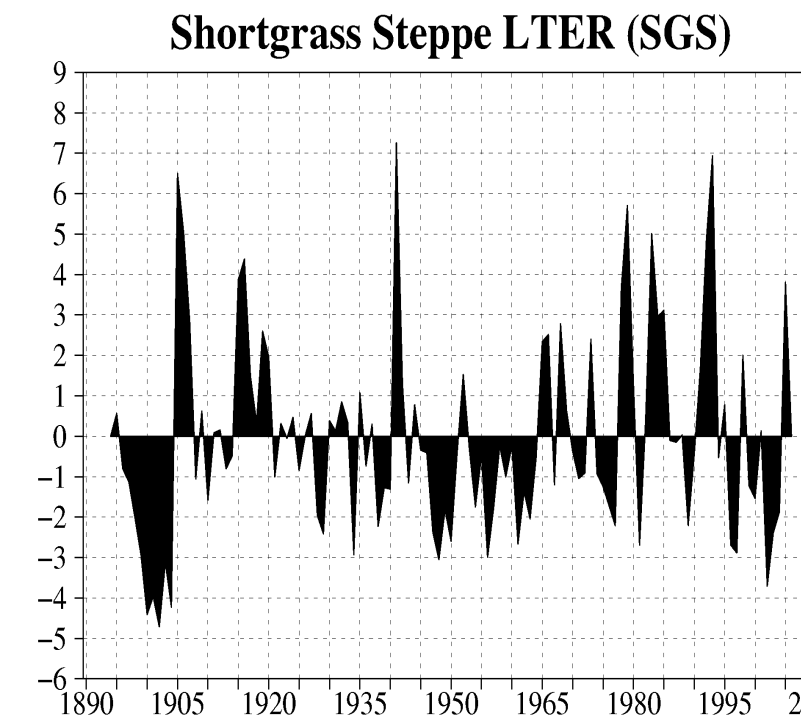
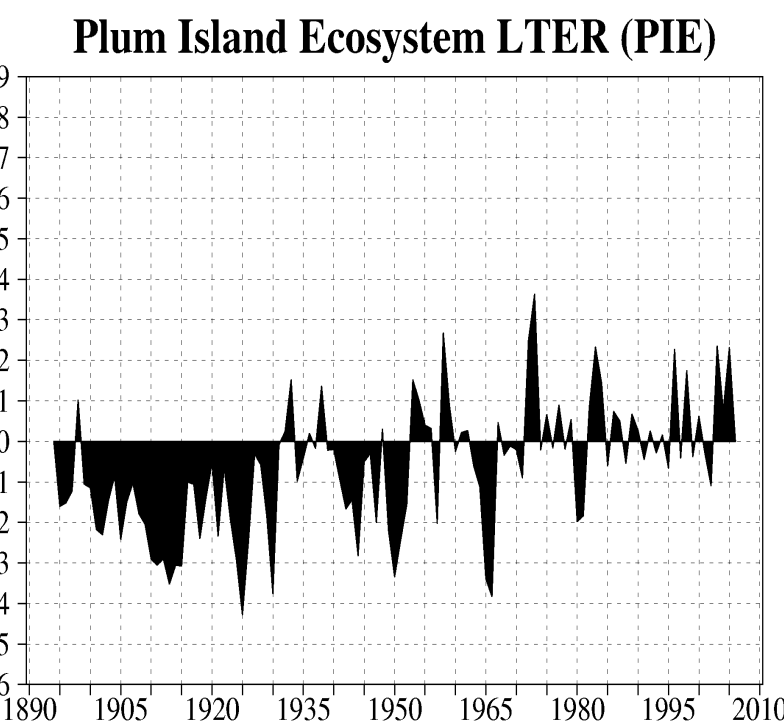
Examples of among-site trends

Palmer Drought Severity Index

Western grasslands

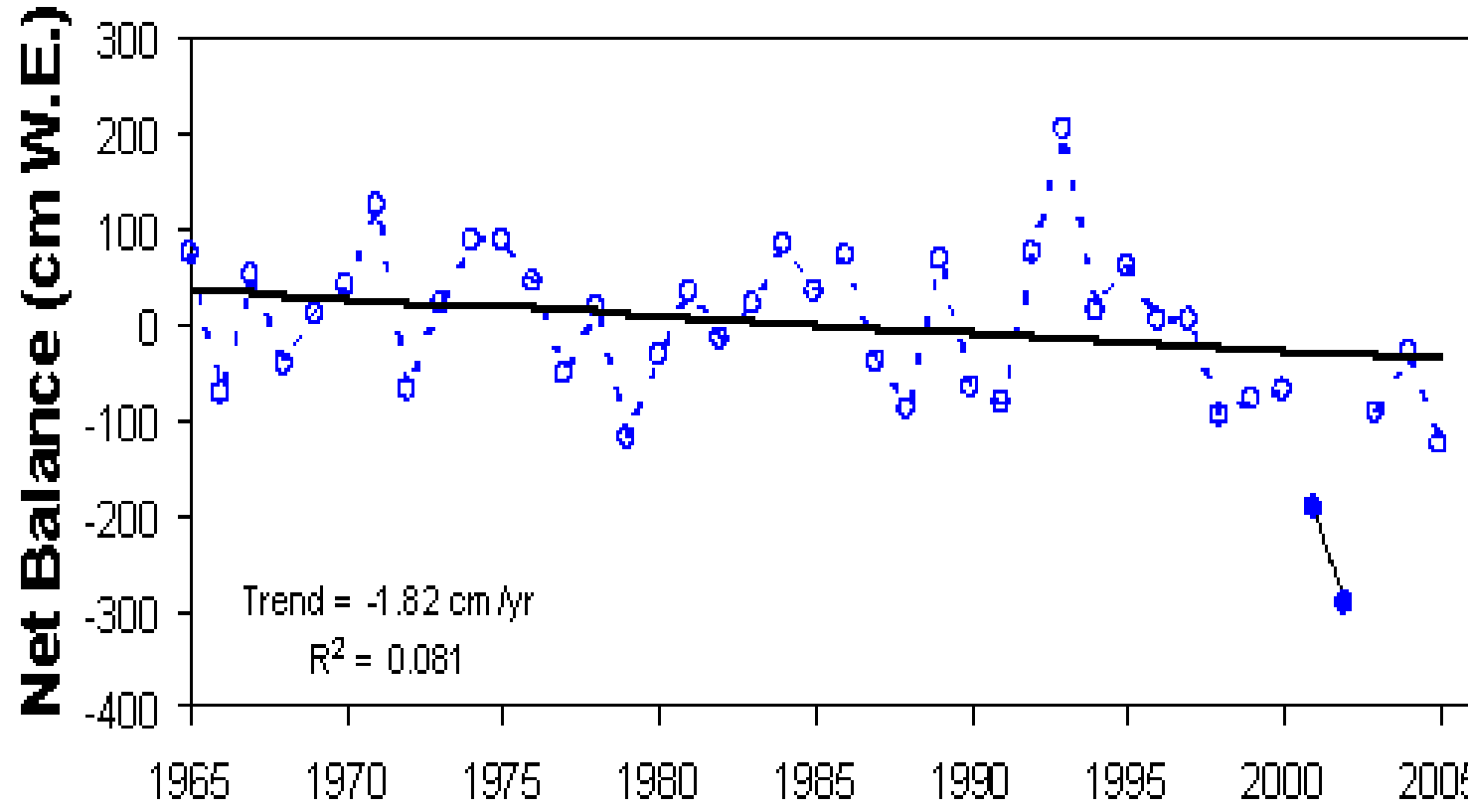


Eastern Coastal



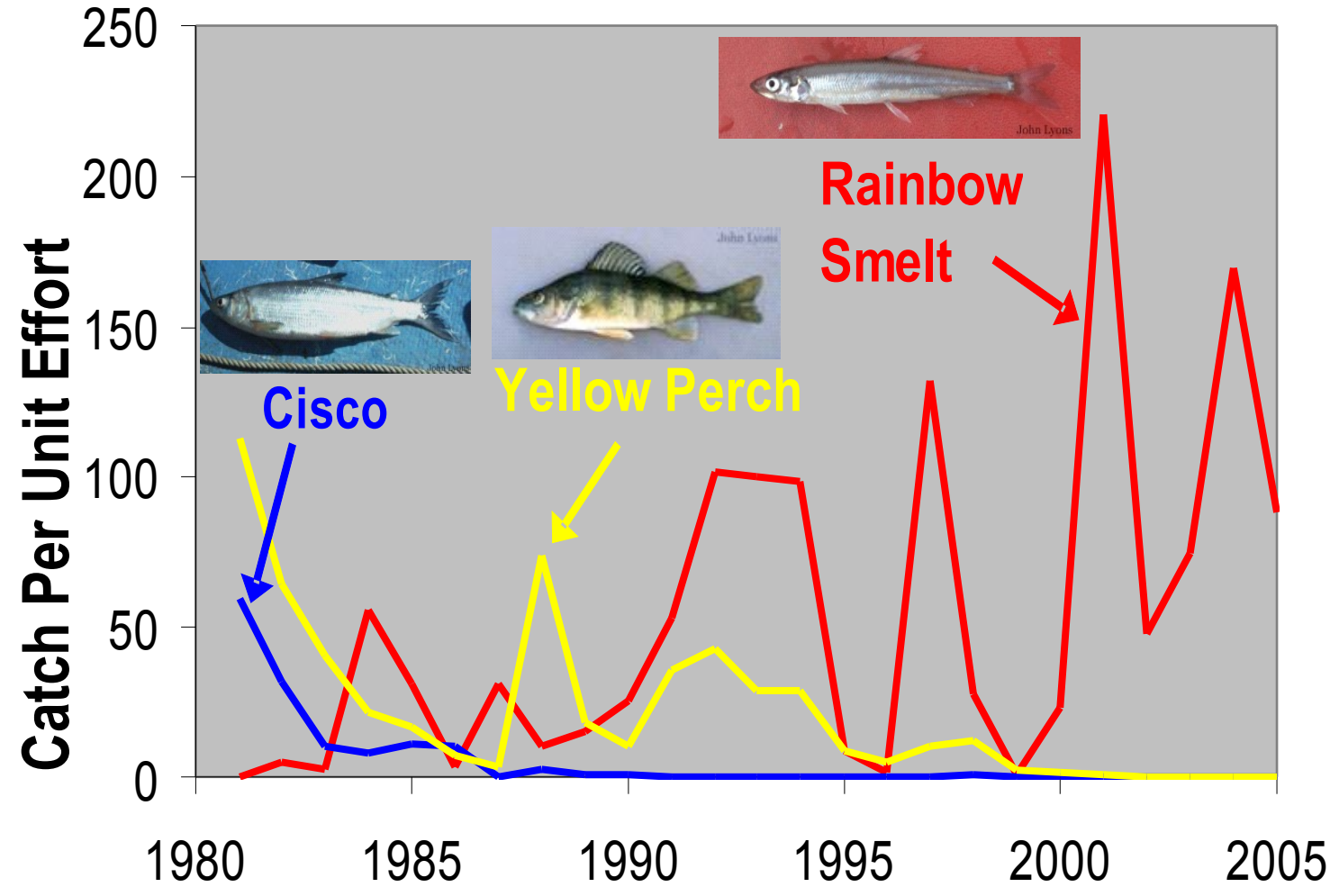
Annual Palmer Drought Severity Index (based on monthly averages) for four each of western grassland and eastern coastal sites. Data obtained from <http://www.ncdc.noaa.gov/oa/climate/onlineprod/drought/xmgr33.html>.

Climate and physical variability



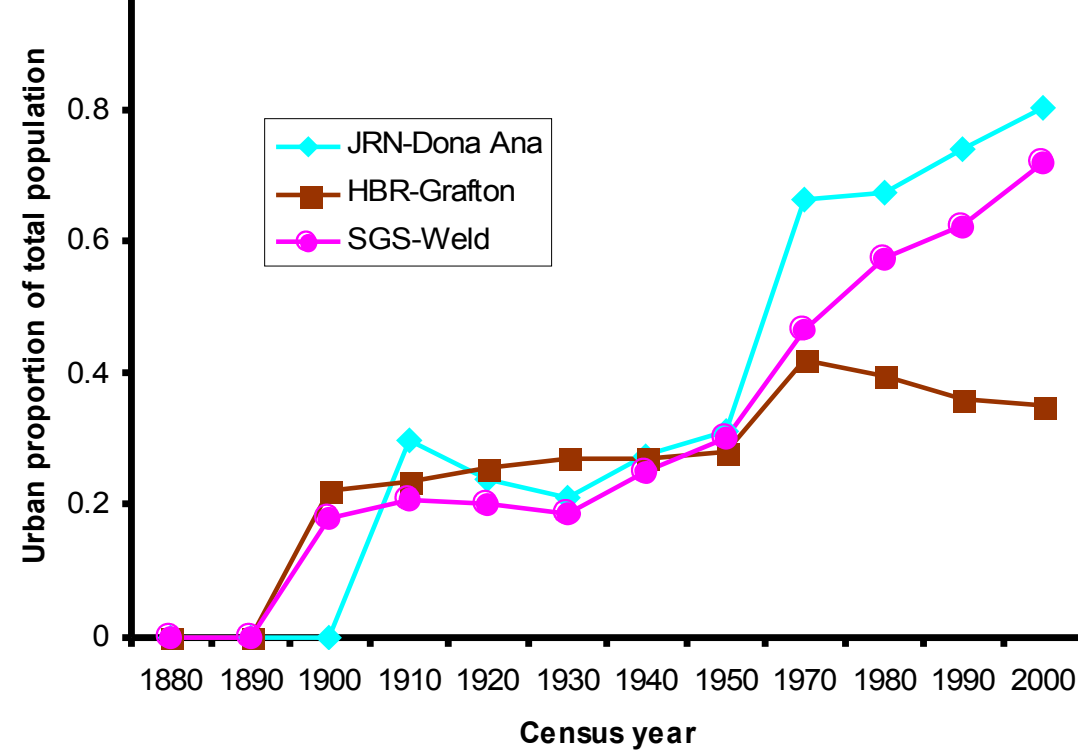
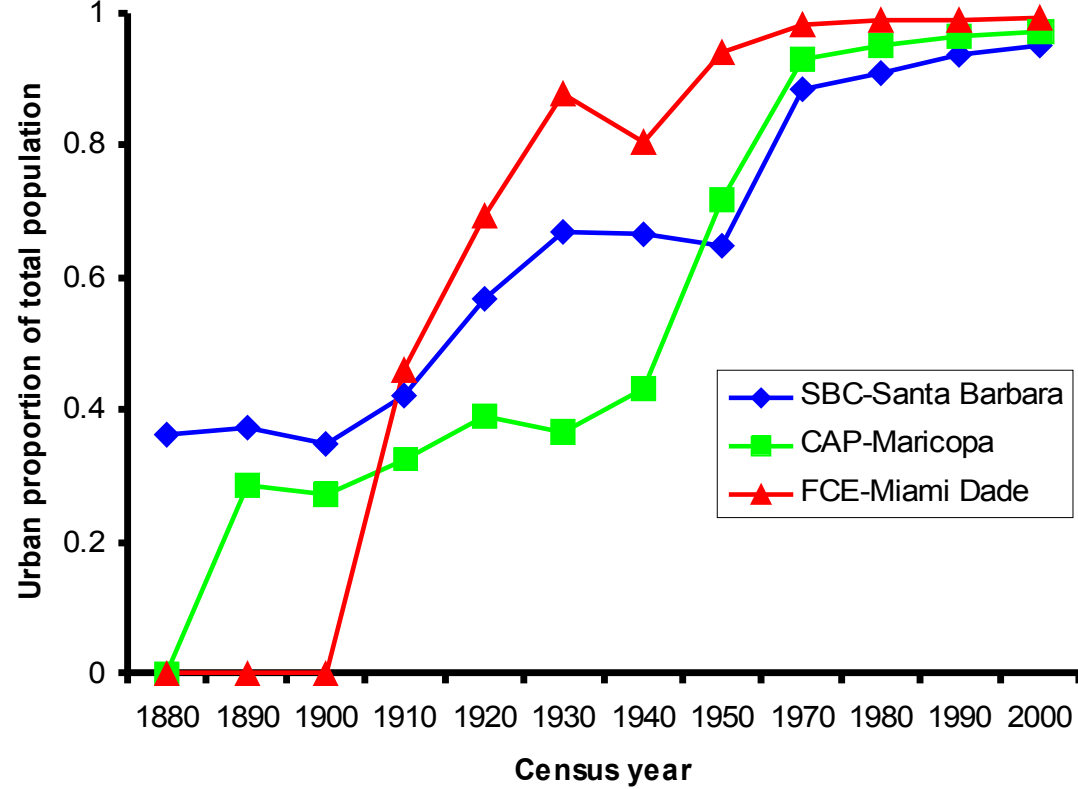
Mass balance of water (accumulation minus melt of snow and ice over the year) showing a net loss of water from a Rocky Mountain glacier through time. Winter precipitation in Green Lakes valley in 2001 and 2002 was only 65-70% of average, the lowest in 30 years of record (NWT LTER: Nel Caine).

Biotic structure



Rainbow smelt is an aquatic invasive species that became established in Sparkling Lake Wisconsin in the early 1980s. It has caused the elimination of two native species, cisco via direct predation, and yellow perch through competition among juvenile fish. These data are annual catch per unit effort data collected by the North Temperate Lakes LTER site. Sparkling Lake is one of 11 focal study lakes.

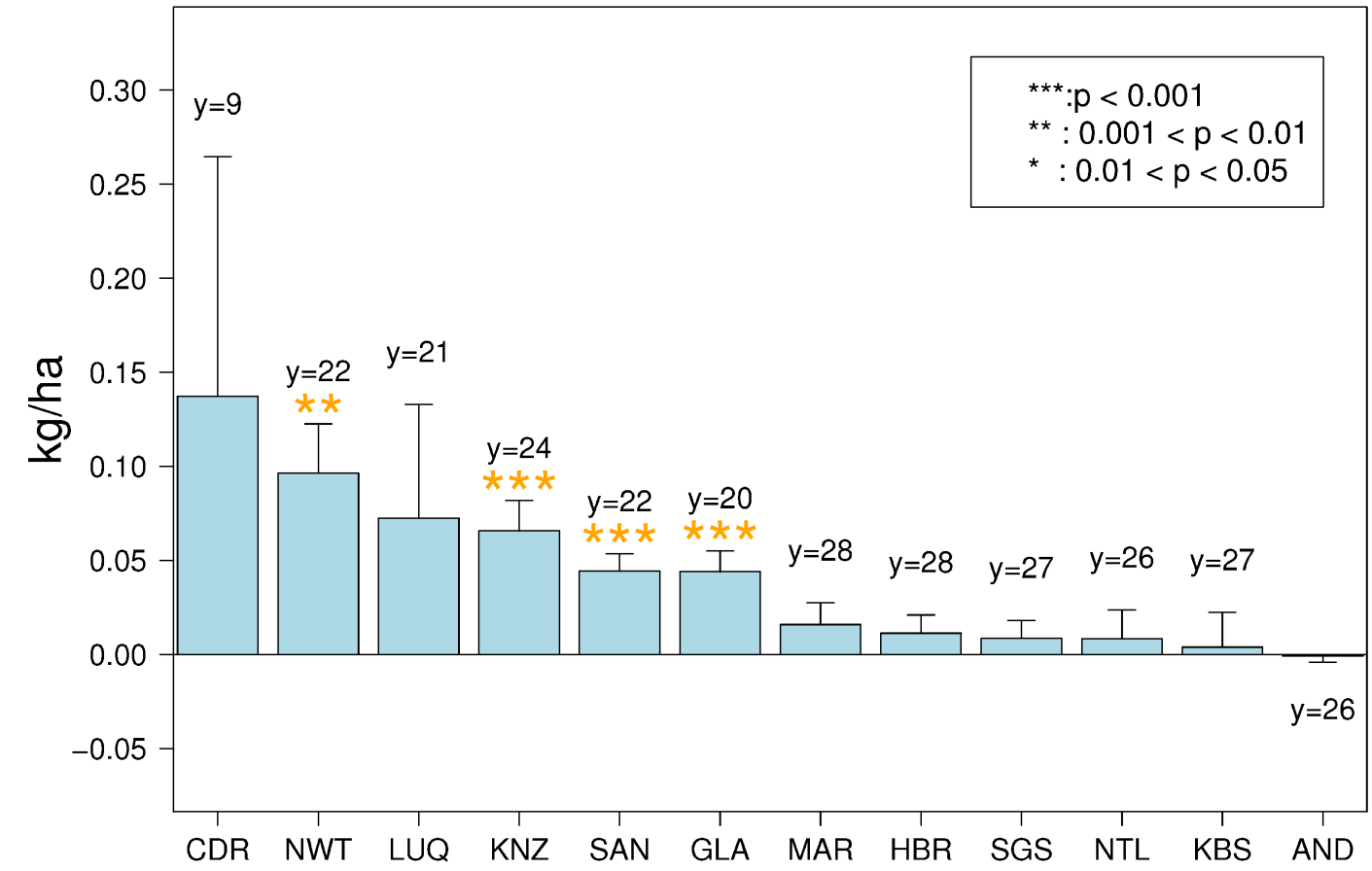
People and landuse



Urban proportion of historically urban counties (top) and historically rural counties (bottom) over time. 1790-1960 Database compiled by Chris Boone, Arizona State University. 1970-2000 Database compiled by Nichole Rosamilla and Ted Gragson, University of Georgia

Biogeochemistry

Mean change in total deposition of N from Ammonia by precipitation per year



Comparison of change in deposition of nitrogen in the form of ammonia by precipitation for all years observed. Error bar indicates standard error. Data obtained from the National Atmospheric Deposition Program at <http://nadp.sws.uiuc.edu/>. Site abbreviations available near top of poster.